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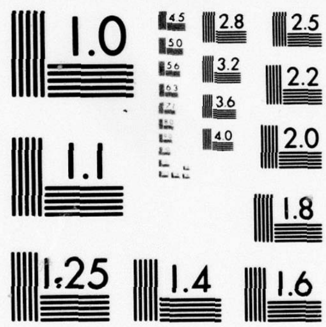

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report summarizes technique, estimated precisions and results for ^3H and ^3He analyses made on three cruises in the Sargasso Sea. In addition, a statistical treatment is made on 36 surface (<10 m) $^3He/^4He$ analyses to obtain an estimate of the solubility isotope effect and its temperature dependence to be $(\alpha - 1) \times 1000\ ^o/oo = -(17.3 \pm 0.8) + (0.28 \pm 0.06)\ T\ (^oC)$ with a regression scatter of 2.6 $^o/oo$ and a linear correlation coefficient of 0.640.

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WOODS HOLE OCEANOGRAPHIC INSTITUTION HELIUM ISOTOPE LABORATORY DATA RELEASE NO. 1

by

W. J. Jenkins, W. V. Collentro,
and R. D. Boudreau

WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts 02543

July 1979

TECHNICAL REPORT

Prepared for the Office of Naval Research under Contract N00014-74-C-0262; NR 083-004 and for the National Science Foundation under Grant OCE 76-20485.

Approved for Distribution: [signature] for
Geoffrey Thompson, Chairman
Department of Chemistry

Woods Hole Oceanographic Institution

Helium Isotope Laboratory

Data Release No. 1

July, 1979

W. J. Jenkins, W. V. Collentro and R. D. Boudreau

Table of Contents

Abstract

This report summarizes technique, estimated precisions and results for ^3H and ^3He analyses made on three cruises in the Sargasso Sea. In addition, a statistical treatment is made on 36 surface ($\leq$ 10 m) $^3He/^4He$ analyses to obtain an estimate of the solubility isotope effect and its temperature dependence to be

$$(\alpha - 1) \times 1000\ ^o/oo = -(17.3 \pm 0.8) + (0.28 \pm 0.06)\ T\ (^oC)$$

with a regression scatter of 2.6 $^o/oo$ and a linear correlation coefficient of 0.640.

1. Introduction

This report serves three purposes: it summarizes the analytical techniques (sections 1(a) through 1(d)); it presents a preliminary analysis of surface and near surface water helium isotope ratio anomalies to allow an evaluation of the isotope effect on solution (section 2); and, it presents data obtained by this laboratory from some recent cruises (sections 3 and 4). It is presently intended that this report be the first in a series of data releases which will occur periodically, and represent the primary form of data report and update on analytical techniques.

(a) Sampling Technique

Samples are drawn from standard oceanographic sample bottles (Niskin and Nansen bottles) by a simple gravity feed technique through tygon tubing. The sampler itself consists of a ca. 1 m length of 0.95 cm or 1.27 cm O.D. annealed, dehydrated copper refrigeration tubing, which is pinched at either end with standard refrigeration tube pinch-clamps (Imperial-Eastman type 105-FF) and mounted in an aluminum channel. The sample is transferred to the sampler by initially raising the sampler above the height of the bottle, opening the lower stopcock, opening the vent and then lowering the sampler slowly so that the air resident in the sampler is displaced slowly by the seawater. After gravity flow is established, the sampler is tapped to remove any air bubbles remaining. When several volumes of water have flushed through the sampler, the sampler is sealed by tightening the pinch-clamps. The samplers are then rinsed in fresh water and the ends rinsed out with a wash bottle of fresh water. The useful shelf-life of samples in these containers, with proper sampler preparation and post-sampling treatment is about two

years. Severe reductions in this shelf-life result from exposure to water or humid conditions, or from storage with water in the ends. Also, the clamp gap is critical for the strength of the seal.

(b) Sample Extraction

The sampler is connected via a viton o-ring coupling to an all metal extraction system which is subsequently baked (at 150°C) and evacuated to a pressure of better than 2×10^{-5} torr. After isolation from the diffusion pump, the sample is introduced into the system by rerounding the bottom pinch-seal slightly and allowing the sample to dribble into a ca. 200 ml Corning type 1720 aluminosilicate glass reservoir where it is shake-stirred for ten minutes. The helium is then transferred to an aluminosilicate glass breakseal sample tube by chilling the sample tube with liquid nitrogen. In this process, the major gases (N_2, O_2 and Ar) exsolved from the sample are adsorbed on activated charcoal inside the sample tube, and the exsolved He and Ne are swept over into the sample tube by water vapor transfer through the seal-off constriction (1 mm I.D. by 20 mm length) of the sample tube. The H_2O vapor pressure difference maintained by the water (about 25 torr) serves to quantitatively sweep over the He and Ne into the sample tube and keep it there. This procedure has been determined mass spectrometrically (both on-line and by re-extraction) to be quantitative (better than 99.9% recovery). The small amount of water transferred to the sample tube (ca. 500 mg) is not sufficient to significantly effect the $^3He/^4He$ ratio of the sample during storage for typical oceanic tritium levels ($\leq$20 T.U.), and could in principle be accounted for. The helium sample is then "saved" by flame-sealing the constriction and stored for future analysis.

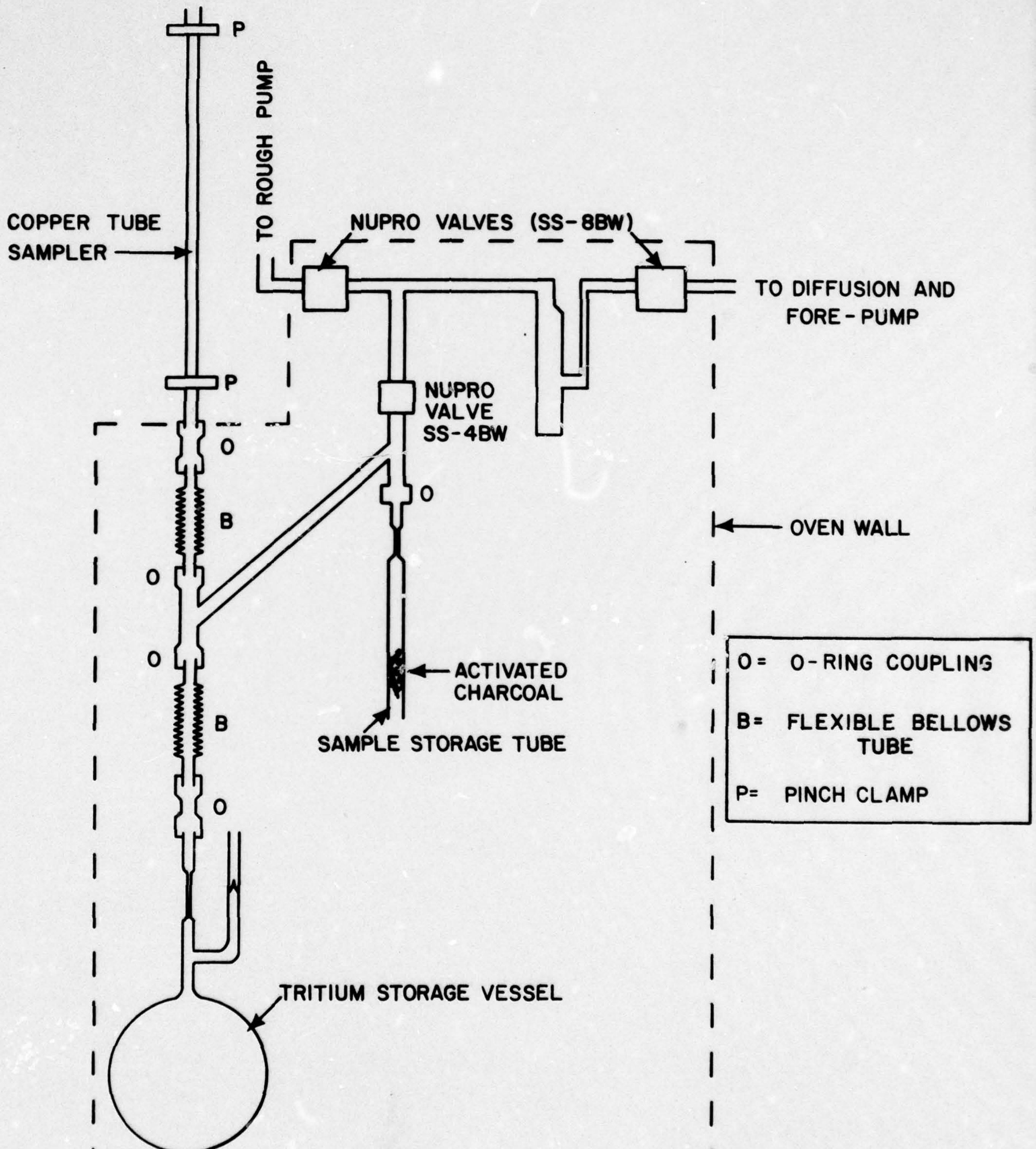
P
TO ROUGH PUMP
COPPER TUBE SAMPLER
NUPRO VALVES (SS-8BW)
TO DIFFUSION AND FORE-PUMP
P
NUPRO VALVE SS-4BW
O
B
O
OVEN WALL
O
O= O-RING COUPLING
ACTIVATED CHARCOAL
B
B= FLEXIBLE BELLOWS TUBE
SAMPLE STORAGE TUBE
P= PINCH CLAMP
O
TRITIUM STORAGE VESSEL

Figure 1

The procedure is checked (i.e. for completeness of extraction and presence of leaks) by watching for a pressure surge when the pump isolation valve is opened again (the water vapor pressure is "masked" by a liquid nitrogen chilled trap), and the sample is further agitated to ensure complete degassing. The reservoir (actually a storage container with breakseal and seal-off constriction) is subsequently sealed off. The sample is then stored in a chest freezer (-20°C) to reduce diffusive influx of He during the ^3H-^3He growth period (12 months). To further reduce the contribution from He exsolving from the glass container itself, the container had been treated prior to extraction by heating for ca. 10 hr to 350°C in a helium-free (pure N_2) atmosphere.

(c) Helium Isotope Analysis

The isotopic ratio of the helium extracted from the samples is analyzed in the "batch mode" mass spectrometrically. The mass spectrometer used is a specially designed, Shields type, dual collecting, statically operated, 90° magnetic sector, single focussing, 25 cm radius mass spectrometer with an electron impact Nier type source. ^4He is collected on a faraday cup and the current measured by a 10^{10} ohm grid-leak solid state electrometer and frequency modulated (VFC) at 100 KHz. The ^3He was detected and amplified by a 20 stage focussed mesh electron multiplier (gain $\sim 10^5$) operated in the current integrating mode and measured and digitized as with ^4He. Both digital and analog records are made, but the computations are performed from the digital data. An analysis consists of nine integrations of 90 sec each on the ^3He and ^4He peaks simultaneously, separated and bracketed by 10 second integrations on the respective baselines.

The isotopic ratio is computed as an isotopic ratio anomaly relative to air, which was used as the calibration standard. Sample analyses are bracketed by air aliquot analyses. The instrument is calibrated for non-linearity, i.e. apparent ratio variations in otherwise identical samples of differing sizes. The corrections applied to the samples due to this effect are typically less than 2 σ of analytical precision. This non-linearity is periodically examined by analysis of aliquots of varying isotopic ratios and determined to be solely a function of ^{4}He (i.e. total gas pressure) in the instrument. No effects occur due to variation (in sample) of Ne concentrations, because the inlet procedure precludes significant amounts of Ne entering the spectrometer. The sample is "chromatographed" into the spectrometer through liquid nitrogen chilled activated charcoal for a precisely determined period of time, during which about 60% of the He enters the instrument, but only about 2% of the Ne comes through. Tripling the Ne concentration in the air standard shows no significant change in the apparent ^{3}He/^{4}He ratio response. Consequently, the small (ca. 20%) difference in He/Ne ratios between air standards and samples gives no effect.

The chromatographic procedure used fractionates ^{3}He in favor of ^{4}He. This effect is corrected for by processing air standards in an identical fashion through the same system. Great care is exercised in analytical procedure because variations in the procedure (column cooling, etc.) leads to random errors and degrades analytical precision. Analytical precision is estimated by the reproducibility of air standards.

(d) Tritium Measurements

The tritium analyses are accomplished by mass spectrometric analysis of ^3He resulting from ^3H decay during storage of the initially degassed water samples (1) in the aluminosilicate storage vessels mentioned earlier. The ^3He is extracted from the samples by what amounts to the "head-space" technique. The sample is defrosted (cf. sec. 1 (b)) and stirred vigorously. The volume of the container is about 200 ml, and the solubility of He is such that at 22^{o}C, 99.8% of the trituigenic ^3He resides in the headspace for a 45 g sample (99.4% for a 90 g sample). The sample is water vapor diffusion pumped from the vessel in an evacuated, all metal sample handling line directly coupled to the mass spectrometer. Mass spectrometric analysis consists of four 100 second integrations on the ^3He and ^4He peaks bracketed and separated by 100 second integrations on the respective baselines.

The standard used in analysis consists of aliquots of volumetrically reduced air standards. The technique used is to generate two daily calibration curves. One curve consists of the ^4He response as a function of the number of aliquots (anywhere from 0 to 8 aliquots are admitted), and a second curve consists of ^3He response vs. ^4He response. A linear regression of the former yields a precise estimate of the line processing blank (the intercept) and the sensitivity (the slope). A linear regression of the latter gives the instrumental discrimination function, the scatter about which is the analytical precision. By this method, instrumental sensitivity and discrimination is determined to the order of a few per mil; i.e. better than analytical precision. The discrimination function is used in conjunction with the sample's ^4He measurement to correct for "atmospheric

contribution". Analysis of evacuated storage vessels (stored for the same period of time under identical circumstances) shows this contribution (presumably He exsolved from the glass itself) to be within analytical precision (a few percent) of the atmospheric ratio. The ^3He contribution from this component is equivalent to about 0.8 T.U. for a 45 g sample stored for one year. The standard aliquots are usually around 5×10^{-15} cc (STP) ^3He, corresponding to about 0.7 T.U.

(e) Computation, Assumptions and Definitions

The helium concentrations are measured by mass spectrometric peak height comparison of the sample with air standards. Reproducibility of air standards varied from batch to batch and has been improving with time as the technique is improved. It is typically of the order of 1%; but recent analyses are now close to 5 ^{o}/oo. The air standard size is computed using the measured temperature, relative humidity and barometric pressure, and assuming 5.24×10^{-6} ppmv helium concentration in air. Sample weights were obtained by difference (sampler full vs. sampler empty) to $\pm$ .01 g (0.3 ^{o}/oo).

The helium isotopic ratio anomalies (DEL-3HE) are expressed in per mil and computed according to

$$\delta\ (^3He) \equiv (R_S/R_A - 1) \times 1000\ ^o/oo,$$

where R_S and R_A are the isotopic ratios ($^3He/^4He$) of the sample and air respectively. This value has been corrected for instrumental effects (size dependence) and in storage decay of tritium.

The excess ^3He concentrations (in cc (STP)/g) and T.U.) were computed assuming that all of the excess helium (above solubility equilibrium at one atmosphere, potential temperature, and salinity, using data from (2)) was

entrapped, unfractionated air due either to sea surface bubble injection, or bubble trapping in the sampler. The relation used was

$$C\,(^3He) = \delta\, RC/1000 + (1 - \alpha)\, RC^*$$

where $C\,(^3He)$ is the concentration of excess ^3He, δ is the isotopic ratio anomaly (in per mil, defined earlier), R is the atmospheric ratio (1.384×10^{-6}, after (1)) C is the helium concentration, α is the solubility isotope partitioning coefficient (see below), and C* is the solubility helium concentration. The (multiplicative) conversion factor from cc STP/g to T.U. (10^{-18} atoms per 'H) is

$$\frac{4.022 \times 10^{14}}{(1 - S/1000)} \quad \text{T.U. -g/cc (STP)}$$

The tritium concentrations are computed by mass spectrometric peak height comparison with air standards of comparable size. They are corrected for atmospheric helium contamination, fractionating water vapor loss (see (1)), and machine performance; and are decay corrected to the date of sampling. The assumed half-life of tritium is 12.262 y. As pointed out by Clarke et al. (1) this may be revised upward in future, but will result in only small (ca. 1%) changes in the values since the primary standard is air rather than the NBS standard used by others.

2. The Isotope Effect in Solution

A cornerstone to the ^3H-^3He dating technique and the calculation of the excess ^3He concentrations is a knowledge of the helium solubility isotope effect: we must know what the baseline $^3He/^4He$ ratio is. Weiss (3) made a determination of the isotope effect for water and seawater. The

problems are that first, only two measurements were made for seawater in the relevant temperature range (0-25°C); second, the analytical accuracy was of the order of 3 °/oo for (i.e. about 2 σ of our current analytical precision); and third, the measurements were made by microgasonometric techniques at a partial pressure of one atmosphere of ^3He, necessitating a twelve orders of magnitude extrapolation. A fourth concern, one which is more difficult to address, involves the possibility that the natural environment due to partial bubble dissolution, dynamic diffusion effects, etc., may not resemble an equilibration chamber.

Consequently, we have compiled a number of near surface (shallower than or equal to 10 m depth) sample analyses and assumed these to be representative of the "initial" conditions. These results include only those obtained by this laboratory since it is not known whether systematic effects may occur between laboratories on the 1 °/oo level. The samples were taken from a variety of ocean environs (coastal vs. open ocean vs. Mediterranean, calm vs. stormy) and no significant salinity effect was observed (or expected) over the range covered (32 °/oo to 38 °/oo).

The data, plotted in Figure 2, exhibit a significant temperature dependence. A linear regression (solid line) yields a relation of

$$(\alpha - 1) \times 1000\ {}^{o}/oo = -(17.3 \pm .8) + (0.28 \pm 0.06)\ T\ (^{o}C)$$

with a regression scatter of 2.6 °/oo and a linear correlation coefficient of 0.640. For the 36 points used, the correlation probability is greater than .999. The regression scatter is slightly higher than analytical precision and may be due to variation of systematic errors betweeen analysis batches, or natural variations due to the effects mentioned earlier.

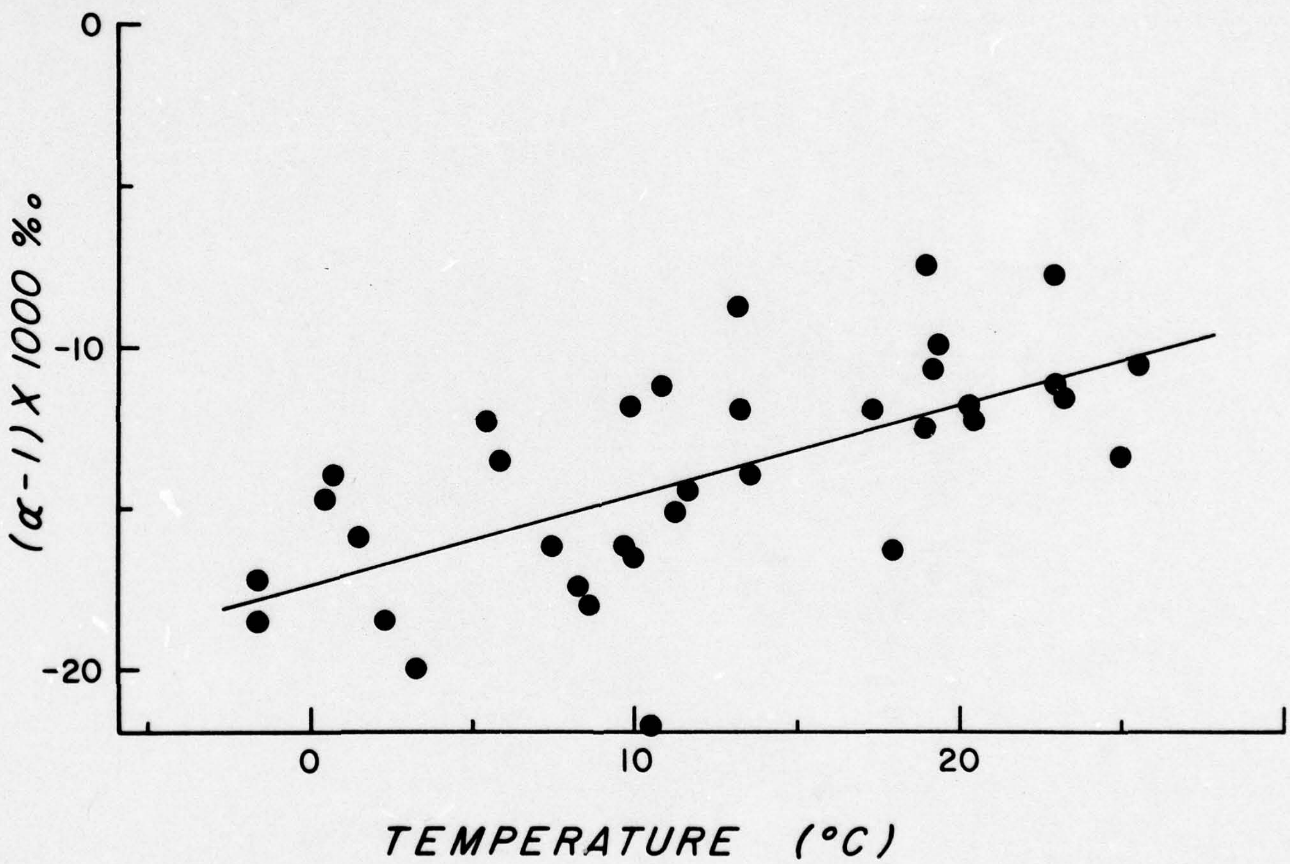

Figure 2

3. Cruise Descriptions

The data contained in this report are on samples taken on two cruises and from a monitoring station.

(a) Sarg 74

These stations (labelled S74###) were taken during KNORR cruise 43 November to December, 1974, from Bermuda to Woods Hole, L.V. Worthington, Chief Scientist. The general area of operations was between 30°N and 36°N near 68°W, with one station at 33.5°N, 56.5°W. The hydrographic data was generously supplied by L. V. Worthington and his co-workers.

(b) Sarg 75

These stations (labelled S75###) were occupied on KNORR cruise 48, March, 1975, L. V. Worthington, Chief Scientist. Details as with Sarg 74.

(c) Pan 77

The Panulirus samples (PAN###) were taken at the Bermuda Monitoring Station (32.2°N, 64.5°W) by BBS personnel on the Panulirus II. Hydro data courtesy of BBS and E. Schroeder.

(d) Data Quality

The relative precisions of analysis varied with the cruise, since improvements in technique came gradually. Since the samples were drawn from Nansen bottles, no duplicates were available (limited water volume!), so that analytical precision was estimated from reproducibility of standards.

TABLE 1

Data Quality

Cruise	Helium		Tritium	
	(^{3}He)	C (He)	Relative Error	Detection Limit
	$^o/oo$	%	(%)	(T.U.)
Sarg 74	2.0	1.4	4	.20
Sarg 75	2.0	1.0	4	.15
Pan 77	1.8	0.75	2	.08

5. References and Acknowledgements

(1) W. B. Clarke, W. J. Jenkins and Z. Top (1976). Determination of tritium by mass spectrometric measurement of ^{3}He. Int. J. App. Rad. Isotopes 27: 515-522.

(2) R. F. Weiss (1971). The solubility of helium and neon in water and seawater. J. Chem. Engg. Data 16: 235-241.

(3) R. F. Weiss (1970). Helium isotope effect in solution in water and seawater. Science 168: 247-248.

(4) We are grateful to L. V. Worthington who gave generously of shiptime, inspiration and hydrographic data for the Sarg cruises, and to E. Schroeder and the Bermuda Biological Station personnel for cooperation and hydrographic data for the Panulirus stations. The mass spectrometer was constructed by the artistry of C. J. Peters, Jr., and would not have been possible but for the support of D. W. Spencer and the more-than-occasional end-run of S. Kadar. Analytical and logistical support was provided for the Sarg cruises by O.N.R. Contract #N00014-74-C0262, and for the Panulirus stations by N.S.F. Grant No. 76-20485.

TABLE 2

STATION S74542 18/11/74 30.50 X 56.50 DEPTH = 4638. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
4.	22.77	36.210	24.936	4.97	****	*****	*****	*****	*****
20.	22.76	36.204	24.935	4.95	****	*****	*****	*****	5.46
50.	22.73	36.220	24.955	4.95	****	*****	*****	*****	5.53
75.	22.46	36.249	25.055	4.90	****	*****	*****	*****	*****
100.	21.89	36.478	25.390	4.59	****	*****	*****	*****	*****
125.	20.10	36.519	25.911	4.54	****	*****	*****	*****	*****
150.	19.57	36.528	26.058	4.42	****	*****	*****	*****	6.72
175.	19.00	36.486	26.174	4.75	****	*****	*****	*****	5.96
197.	19.04	36.498	26.173	4.55	****	*****	*****	*****	*****
222.	18.74	36.480	26.236	4.45	****	*****	*****	*****	6.75
245.	18.33	36.460	26.324	4.39	****	*****	*****	*****	6.23
270.	18.03	36.444	26.387	4.41	****	*****	*****	*****	6.26
318.	17.59	36.250	26.347	4.44	****	*****	*****	*****	6.13
318.	17.59	36.250	26.347	4.44	****	*****	*****	*****	6.44
392.	16.99	36.343	26.564	4.43	****	*****	*****	*****	5.66
441.	16.35	36.211	26.614	4.52	****	*****	*****	*****	5.48
491.	15.73	36.138	26.702	4.16	****	*****	*****	*****	4.61
588.	13.93	35.832	26.862	4.09	****	*****	*****	*****	*****
685.	11.75	36.522	27.837	3.60	****	*****	*****	*****	2.24
783.	9.31	35.211	27.252	3.42	****	*****	*****	*****	*****
979.	6.32	35.099	27.610	4.70	****	*****	*****	*****	*****

STATION S74546 18/11/74 30.50 X 67.50 DEPTH = 4815. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	23.99	36.535	24.825	5.01	****	*****	*****	*****	6.63
25.	23.97	36.545	24.839	5.03	****	*****	*****	*****	6.45
50.	23.43	36.506	24.969	4.98	****	*****	*****	*****	6.42
75.	23.42	******	24.975	5.40	****	*****	*****	*****	5.46
100.	20.23	36.514	25.872	5.10	****	*****	*****	*****	6.02
125.	19.57	36.501	26.037	4.89	****	*****	*****	*****	5.71
150.	19.17	36.480	26.125	4.82	****	*****	*****	*****	5.68
174.	18.93	36.470	26.179	4.79	****	*****	*****	*****	7.76
199.	18.74	36.464	26.223	4.70	****	*****	*****	*****	*****
224.	18.45	36.459	26.293	4.73	****	*****	*****	*****	5.68
249.	18.28	36.469	26.344	4.56	****	*****	*****	*****	*****
274.	17.96	36.447	26.407	4.56	****	*****	*****	*****	6.27
299.	17.82	36.442	26.438	4.55	****	*****	*****	*****	6.47
324.	17.67	36.440	26.473	4.54	****	*****	*****	*****	5.79
349.	17.52	36.447	26.515	4.50	****	*****	*****	*****	5.94
374.	17.39	36.426	26.531	4.49	****	*****	*****	*****	6.14
399.	17.25	36.405	26.549	4.44	****	*****	*****	*****	5.18
424.	17.03	36.376	26.580	4.42	****	*****	*****	*****	5.85
448.	16.83	36.336	26.597	4.40	****	*****	*****	*****	5.69
498.	16.32	36.251	26.652	4.31	****	*****	*****	*****	4.92
548.	15.63	36.141	26.727	4.13	****	*****	*****	*****	4.25
598.	14.69	35.973	26.807	4.06	****	*****	*****	*****	4.00
647.	13.64	******	26.915	4.21	****	*****	*****	*****	3.26
697.	12.73	35.671	26.984	3.82	****	*****	*****	*****	3.05
797.	10.48	******	27.227	3.44	****	*****	*****	*****	*****
896.	8.63	35.202	27.355	3.54	****	*****	*****	*****	0.81
996.	*****	35.106	27.858	4.11	****	*****	*****	*****	0.96

STATION S74548 19/11/74 32.50 X 67.50 DEPTH = 4696. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	23.01	36.397	25.009	4.92	4.00	-8.1	0.11	0.04	5.77
25.	23.12	36.479	25.039	5.70	4.19	-12.4	-0.17	-0.07	6.46
50.	23.02	36.499	25.083	5.00	****	*****	*****	*****	6.60
75.	23.02	36.512	25.093	4.98	3.86	-16.8	-0.34	-0.14	6.24
100.	20.70	36.537	25.763	5.24	3.92	6.4	0.94	0.39	5.57
125.	19.74	36.525	26.011	4.96	3.95	5.2	0.89	0.37	5.36
150.	19.25	36.501	26.121	4.79	3.96	6.3	0.96	0.40	5.56
175.	19.02	36.482	26.165	4.76	3.97	12.8	1.32	0.55	6.29
200.	18.95	36.563	26.245	4.38	3.88	45.8	3.07	1.28	6.15
225.	18.69	36.530	26.287	4.49	4.00	43.4	3.02	1.26	6.27
250.	18.52	36.516	26.319	4.25	3.99	66.0	4.27	1.78	6.32
275.	18.19	36.497	26.388	4.18	3.95	78.8	4.94	2.06	*****
300.	17.97	36.482	26.431	4.34	3.91	77.1	4.80	2.00	6.88
325.	17.68	36.441	26.471	4.43	4.13	67.3	4.48	1.87	5.84
349.	17.51	36.427	26.502	4.40	4.05	73.2	4.74	1.98	6.41
374.	17.33	36.409	26.532	4.40	4.44	75.5	5.28	2.20	6.45
399.	17.14	36.387	26.562	4.41	3.97	79.9	5.03	2.10	6.44
424.	16.95	36.366	26.591	4.38	4.07	86.3	5.51	2.30	6.33
449.	16.74	36.322	26.607	4.35	****	*****	*****	*****	*****
499.	15.99	36.188	26.680	4.19	****	*****	*****	*****	*****
549.	15.14	36.042	26.761	4.14	4.02	73.5	4.77	1.99	5.29
599.	14.32	35.911	26.840	4.00	****	*****	*****	*****	*****
649.	13.58	35.784	26.898	3.83	****	*****	*****	*****	*****
699.	12.56	35.650	27.002	3.75	****	*****	*****	*****	3.48
799.	10.23	35.332	27.190	3.37	****	*****	*****	*****	1.35
899.	8.13	35.150	27.392	3.71	****	40.3	*****	*****	1.29
999.	6.61	35.091	27.564	4.36	4.29	29.1	2.55	1.06	1.05

STATION S74550 19/11/74 34.50 X 67.50 DEPTH = 5042. M.
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DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	22.90	36.366	25.017	4.91	4.19	-10.0	-0.02	-0.01	5.80
25.	22.80	36.378	25.055	4.89	4.26	-10.8	-0.08	-0.03	5.81
50.	22.69	36.383	25.090	4.91	4.21	-8.2	0.08	0.03	5.74
75.	22.65	36.395	25.111	4.95	3.98	-8.6	0.09	0.04	5.27
100.	22.61	36.408	25.132	4.93	4.12	-4.5	0.30	0.13	5.78
125.	20.97	36.417	25.598	5.12	****	*****	*****	*****	*****
150.	19.86	36.422	25.901	4.97	4.00	7.6	1.02	0.43	6.21
175.	19.25	36.447	26.079	4.80	3.83	10.6	1.17	0.49	6.05
200.	18.73	36.460	26.223	4.69	3.96	15.8	1.48	0.62	5.89
224.	18.77	36.513	26.253	4.42	3.95	43.1	2.97	1.24	7.00
249.	18.63	36.514	26.290	4.29	3.90	54.2	3.55	1.48	6.20
274.	18.20	36.435	26.338	4.62	****	*****	*****	*****	6.46
299.	18.09	36.457	26.382	4.56	4.04	41.4	2.94	1.23	6.77
323.	17.98	36.452	26.406	4.54	3.93	50.2	3.36	1.40	6.89
348.	17.82	36.444	26.439	4.51	3.95	49.5	3.34	1.39	5.73
373.	17.70	36.435	26.462	4.49	3.96	53.4	3.56	1.48	6.89
398.	17.58	36.423	26.482	4.46	3.96	62.8	4.08	1.70	6.38
423.	17.36	36.402	26.520	4.43	****	*****	*****	*****	5.99
449.	17.19	36.385	26.548	4.40	3.95	84.0	5.24	2.18	5.97
499.	16.78	36.322	26.598	4.36	3.90	78.8	4.90	2.04	4.93
549.	16.20	36.204	26.644	4.39	****	*****	*****	*****	5.50
599.	15.72	36.134	26.701	4.29	4.00	74.4	4.79	1.99	5.28
649.	14.88	35.999	26.785	4.18	4.99	60.1	4.83	2.01	5.03
699.	14.14	35.882	26.856	4.15	3.91	56.9	3.77	1.57	4.31
798.	12.14	35.569	27.022	3.58	4.07	51.3	3.62	1.51	2.90
898.	9.75	35.280	27.232	3.39	****	*****	*****	*****	*****
998.	7.65	35.096	27.421	3.88	4.12	22.3	2.08	0.87	1.17

STATION S74552 20/11/74 36.50 X 67.50 DEPTH = 5075. M.

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DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	23.18	36.305	24.890	4.81	4.38	-9.8	-0.04	-0.02	5.23
25.	23.20	36.295	24.876	4.82	4.34	-10.3	-0.07	-0.03	5.15
50.	23.19	36.279	24.867	4.93	4.09	-11.1	-0.08	-0.03	5.62
74.	23.19	36.290	24.875	4.77	3.92	-12.1	-0.11	-0.04	5.14
99.	23.18	36.292	24.880	4.76	3.98	-6.1	0.22	0.09	5.36
124.	23.18	36.304	24.889	4.77	3.91	-13.5	-0.18	-0.07	4.79
149.	21.63	36.547	25.515	4.68	3.92	8.5	1.04	0.43	5.96
174.	20.62	36.540	25.787	4.60	****	*****	*****	*****	6.53
198.	19.80	36.521	25.992	4.70	3.89	11.9	1.24	0.52	*****
225.	19.52	36.521	26.065	4.63	3.93	15.4	1.44	0.60	6.18
250.	19.23	36.483	26.112	4.72	4.58	14.4	1.52	0.64	*****
275.	19.05	36.478	26.155	4.76	3.84	10.2	1.16	0.48	5.97
300.	18.88	36.482	26.201	4.75	3.89	13.6	1.35	0.56	*****
325.	18.69	36.480	26.248	4.62	4.28	26.1	2.17	0.90	6.46
350.	18.49	36.479	26.298	4.50	4.01	41.5	2.93	1.22	6.14
375.	18.24	36.477	26.360	4.44	4.29	55.9	3.95	1.64	6.61
400.	18.01	36.473	26.414	4.47	4.16	57.7	3.95	1.65	6.54
425.	17.83	36.460	26.449	4.64	4.02	60.1	3.98	1.66	6.53
448.	17.75	36.452	26.463	4.45	4.02	67.4	4.38	1.83	5.76
498.	17.57	36.441	26.498	4.41	3.97	75.3	4.77	1.99	*****
548.	17.02	36.368	26.576	4.03	****	*****	*****	*****	5.77
598.	16.41	36.266	26.642	4.18	4.09	81.4	5.26	2.19	*****
647.	*****	36.190	26.717	4.10	4.89	67.4	5.23	2.18	*****
697.	15.26	36.074	26.759	3.96	4.42	89.4	6.14	2.56	4.27
797.	13.46	35.779	26.919	3.80	4.20	65.0	4.48	1.87	3.63
896.	11.08	35.404	27.094	3.18	4.34	30.2	2.56	1.07	1.42
996.	*****	35.172	27.767	3.18	****	*****	*****	*****	*****

STATION S74554 20/11/74 38.50 X 67.50 DEPTH = 3895. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	18.05	35.516	25.672	5.27	4.31	-3.1	0.45	0.19	*****
25.	17.98	35.509	25.684	5.24	4.45	-1.7	0.53	0.22	*****
50.	17.96	35.506	25.687	5.24	4.30	-8.0	0.16	0.07	8.26
75.	16.47	35.728	26.215	3.79	3.94	41.1	2.90	1.21	6.81
100.	15.35	35.901	26.605	3.55	4.22	60.2	4.19	1.75	4.98
125.	14.02	35.812	26.827	3.51	4.17	61.1	4.22	1.76	3.30
150.	13.20	35.698	26.910	3.38	4.33	54.8	3.99	1.66	*****
175.	12.15	35.554	27.008	3.23	4.06	45.8	3.30	1.37	1.90
200.	11.18	35.415	27.084	3.11	4.34	30.8	2.59	1.08	1.64
224.	10.47	35.331	27.147	3.16	4.11	27.1	2.30	0.96	1.11
249.	9.89	******	27.196	3.16	****	*****	*****	*****	*****
274.	9.33	35.197	27.238	3.17	4.55	23.6	2.26	0.94	0.94
299.	8.78	35.141	27.283	3.25	****	20.4	*****	*****	0.94
324.	8.19	35.090	27.335	3.37	4.52	10.3	1.44	0.60	*****
349.	7.74	35.087	27.401	3.47	4.66	24.5	2.39	0.99	*****
374.	7.54	35.083	27.427	3.74	4.33	28.4	2.51	1.04	0.84
398.	*****	35.073	27.489	4.17	4.62	17.6	1.94	0.81	0.82
423.	6.56	35.061	27.548	4.34	4.77	20.9	2.21	0.92	1.01
439.	6.36	35.057	27.571	4.43	4.32	25.1	2.33	0.97	1.01
488.	5.75	35.035	27.633	4.81	4.48	28.5	2.61	1.09	1.44
537.	5.32	35.028	27.680	5.15	4.23	34.8	2.89	1.20	1.38
586.	5.00	35.010	27.704	5.36	****	*****	*****	*****	*****
635.	4.89	35.005	27.713	5.43	4.14	33.0	2.75	1.14	1.72
684.	4.73	35.002	27.729	5.55	4.28	32.2	2.77	1.15	*****

STATION S75615 27/ 3/75 40.53 X 58.10 DEPTH = 9999. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (‰.)	SIG-THETA (‰.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^-8)	DEL-3HE (%.)	XS-3HE (CC/GX10^-15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	10.94	34.865	26.700	6.46	****	*****	*****	*****	11.23
25.	10.97	34.930	26.745	6.49	****	*****	*****	*****	11.34
50.	11.84	35.255	26.836	6.05	****	*****	*****	*****	7.94
75.	12.08	35.350	26.863	5.84	4.17	-11.8	0.05	0.02	7.61
100.	12.04	35.373	26.889	5.64	4.46	-13.4	-0.10	-0.04	7.40
125.	11.92	35.364	26.905	5.58	4.07	-9.9	0.17	0.07	7.24
150.	11.84	35.365	26.921	5.64	4.54	-8.6	0.19	0.08	6.30
175.	12.09	35.477	26.960	5.16	****	*****	*****	*****	6.24
199.	12.19	35.514	26.969	4.63	****	*****	*****	*****	*****
224.	12.16	35.539	26.994	5.42	4.24	-4.8	0.45	0.19	5.61
247.	12.23	35.558	26.996	5.52	4.11	-7.0	0.33	0.14	7.40
270.	12.20	35.561	27.004	5.37	4.21	-4.3	0.48	0.20	4.17
294.	11.94	35.535	27.034	4.81	****	*****	*****	*****	*****
319.	11.05	35.391	27.089	3.52	4.10	39.9	3.01	1.25	*****
344.	10.41	35.316	27.146	3.37	4.26	21.9	2.05	0.85	1.97
369.	9.84	35.250	27.193	3.35	4.27	21.6	2.04	0.85	*****
395.	9.52	35.219	27.223	3.39	4.19	24.3	2.18	0.91	1.08
420.	9.19	35.183	27.250	3.34	4.95	13.9	1.73	0.72	*****
446.	8.61	35.137	27.307	3.51	5.01	21.5	2.28	0.95	*****
496.	7.91	35.107	27.391	3.70	4.26	23.1	2.16	0.90	0.81
546.	7.38	35.068	27.439	3.93	****	*****	*****	*****	*****
596.	6.64	35.056	27.533	4.41	4.26	19.3	1.96	0.82	0.73
696.	5.54	35.032	27.657	5.13	4.22	23.1	2.19	0.91	0.96
796.	4.99	35.019	27.712	5.48	4.27	37.2	3.05	1.27	1.20
896.	4.63	35.008	27.745	5.85	4.41	25.8	2.44	1.01	1.60
996.	4.45	34.995	27.755	5.85	****	*****	*****	*****	2.39

STATION S75617 28/ 3/75 38.50 X 58.50 DEPTH = 9999. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
10.	17.97	36.071	26.117	5.35	4.01	-15.1	-0.21	-0.09	6.10
25.	17.60	36.054	26.195	5.38	4.03	-14.9	-0.19	-0.08	6.07
50.	16.45	35.964	26.401	5.04	4.19	-3.8	0.44	0.18	6.30
75.	15.68	35.932	26.555	4.96	4.29	14.1	1.51	0.63	5.97
97.	15.46	35.926	26.600	5.37	****	*****	*****	*****	5.80
122.	15.06	35.853	26.633	5.32	****	*****	*****	*****	*****
146.	14.41	35.759	26.703	5.47	4.16	-12.7	-0.04	-0.02	7.16
170.	14.19	35.755	26.747	4.98	4.03	10.1	1.26	0.52	6.05
195.	13.60	35.691	26.822	4.94	4.10	26.3	2.20	0.91	5.20
219.	13.42	35.680	26.851	5.22	****	*****	*****	*****	6.50
244.	13.25	35.660	26.871	4.34	4.15	24.5	2.12	0.88	5.09
268.	12.62	35.608	26.958	4.74	4.25	29.0	2.43	1.01	4.38
292.	12.60	35.574	26.935	4.59	****	*****	*****	*****	4.85
316.	12.32	35.569	26.987	3.98	****	38.4	*****	*****	*****
347.	11.65	35.493	27.057	3.51	****	*****	*****	*****	*****
372.	10.98	35.406	27.114	3.29	4.84	34.9	3.09	1.28	3.02
397.	10.54	35.346	27.146	3.32	4.10	33.8	2.67	1.11	2.16
422.	10.08	35.282	27.177	3.28	3.98	34.1	2.64	1.10	1.32
496.	8.62	35.158	27.322	3.35	4.46	34.1	2.89	1.20	1.35
546.	7.92	35.107	27.390	4.03	4.11	29.6	2.49	1.03	0.77
596.	*****	35.075	27.504	4.00	4.14	31.3	2.61	1.09	*****
696.	6.00	35.048	27.611	4.76	****	*****	*****	*****	0.82
795.	5.34	35.025	27.676	5.18	4.38	39.9	3.27	1.36	1.86
895.	4.97	******	27.716	5.49	****	*****	*****	*****	1.43
995.	4.65	35.017	27.750	5.68	****	*****	*****	*****	2.56

STATION S75619   29/ 3/75   36.50 X 58.50   DEPTH = 9999. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	19.96	36.398	25.856	5.09	****	*****	*****	*****	*****
25.	19.98	36.403	25.854	5.11	****	*****	*****	*****	*****
49.	19.99	36.408	25.856	5.09	4.02	-6.4	0.24	0.10	7.16
74.	20.00	36.418	25.860	5.09	4.31	-5.5	0.27	0.11	7.11
98.	19.36	36.445	26.049	5.12	4.33	-6.6	0.21	0.09	*****
122.	19.32	36.453	26.066	5.13	3.97	-7.6	0.19	0.08	*****
147.	19.29	36.444	26.067	5.17	4.04	-1.1	0.55	0.23	5.48
172.	19.23	36.447	26.085	5.15	4.03	-11.4	-0.02	-0.01	6.37
196.	19.07	36.444	26.124	5.14	****	*****	*****	*****	5.90
220.	19.04	36.447	26.134	5.18	4.04	-7.0	0.22	0.09	5.49
245.	18.92	36.452	26.168	4.92	4.05	14.5	1.43	0.60	5.40
270.	18.58	36.433	26.240	5.15	4.11	-6.6	0.25	0.10	5.42
294.	18.41	36.430	26.281	5.08	4.21	-6.3	0.26	0.11	6.22
318.	18.36	36.433	26.296	4.98	4.34	4.5	0.90	0.37	5.58
343.	18.27	36.431	26.317	5.09	****	*****	*****	*****	6.12
368.	18.18	36.452	26.356	4.82	4.22	23.4	1.99	0.83	6.38
392.	17.96	36.417	26.384	4.94	4.70	18.3	1.82	0.76	6.84
416.	17.83	36.408	26.409	4.68	****	*****	*****	*****	6.26
441.	17.55	36.396	26.469	4.53	5.08	36.5	3.20	1.34	6.63
490.	17.09	36.354	26.548	4.40	4.03	78.6	5.03	2.10	7.06
539.	16.65	36.314	26.623	4.38	4.07	80.9	5.21	2.17	5.84
588.	15.75	36.153	26.708	4.28	4.47	80.3	5.63	2.35	5.09
686.	13.48	35.748	26.891	4.04	****	*****	*****	*****	4.34
784.	11.79	35.539	27.066	3.86	4.38	46.9	3.58	1.49	3.42
882.	9.33	35.231	27.264	3.53	4.16	38.1	2.97	1.24	1.57
982.	7.66	35.125	27.442	3.93	4.14	35.0	2.81	1.17	1.36

STATION S75621 30/ 3/75 34.50 X 58.50 DEPTH = 9999. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	18.95	36.465	26.170	5.26	4.07	-6.8	0.23	0.10	6.18
25.	18.95	36.468	26.173	5.32	****	*****	*****	*****	5.75
50.	18.94	36.467	26.175	5.29	****	*****	*****	*****	5.32
75.	18.97	36.465	26.165	****	4.09	-2.1	0.50	0.21	5.31
100.	18.94	36.467	26.175	5.32	****	*****	*****	*****	5.15
125.	18.82	36.467	26.205	5.30	****	-12.4	*****	*****	5.87
150.	18.73	36.477	26.236	5.31	4.07	-12.4	-0.08	-0.03	6.05
175.	18.74	36.471	26.229	5.29	4.34	1.6	0.71	0.30	5.93
200.	18.72	36.469	26.232	5.31	4.00	4.5	0.87	0.36	5.57
225.	18.72	36.477	26.238	5.29	4.26	-2.7	0.46	0.19	6.07
250.	18.69	36.461	26.234	5.23	4.13	-2.9	0.45	0.19	6.23
275.	18.44	36.446	26.286	4.97	****	*****	*****	*****	5.72
300.	18.34	36.438	26.305	4.94	****	*****	*****	*****	6.22
325.	18.23	36.435	26.330	4.77	****	*****	*****	*****	5.54
348.	17.99	36.437	26.392	4.61	****	*****	*****	*****	*****
372.	17.83	36.433	26.428	4.58	4.82	46.1	3.71	1.55	6.48
397.	17.65	36.426	26.467	4.48	****	*****	*****	*****	*****
422.	17.47	36.418	26.505	4.44	4.29	78.6	5.31	2.21	5.89
447.	17.24	36.410	26.555	4.37	4.21	94.0	6.12	2.55	5.95
496.	16.71	36.405	26.678	4.36	****	*****	*****	*****	5.90
546.	16.01	36.171	26.663	4.30	****	*****	*****	*****	5.78
596.	15.14	36.022	26.745	4.30	4.02	72.3	4.70	1.96	5.30
696.	13.39	35.759	26.918	4.06	****	*****	*****	*****	*****
795.	10.44	35.356	27.172	3.47	4.31	43.0	3.32	1.38	1.90
895.	8.21	35.138	27.370	3.65	****	*****	*****	*****	1.07
994.	6.52	35.075	27.564	4.48	4.05	36.4	2.87	1.19	1.73

STATION S75623 30/ 3/75 32.50 X 58.50 DEPTH = 9999. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
10.	19.35	36.536	26.121	5.24	4.02	-9.2	0.10	0.04	5.82
25.	19.18	36.518	26.152	5.33	4.23	-5.1	0.31	0.13	5.92
50.	19.16	36.518	26.157	5.26	****	*****	*****	*****	5.87
75.	19.19	36.521	26.151	5.25	4.02	-3.0	0.44	0.19	6.12
100.	19.16	36.521	26.159	5.26	4.31	-4.8	0.33	0.14	5.41
125.	19.15	36.516	26.158	5.25	****	*****	*****	*****	5.95
150.	19.14	36.511	26.157	5.24	****	*****	*****	*****	*****
175.	19.14	36.503	26.151	5.20	4.06	3.4	0.80	0.33	5.52
200.	18.79	36.461	26.208	4.94	****	*****	*****	*****	6.41
224.	18.54	36.457	26.269	4.70	4.02	26.2	2.08	0.87	5.78
248.	18.26	36.447	26.332	4.62	4.02	45.7	3.17	1.32	5.98
272.	18.07	36.441	26.375	4.56	3.97	45.4	3.12	1.30	5.55
296.	17.84	36.428	26.422	4.55	4.09	48.4	3.37	1.41	6.48
320.	17.75	36.418	26.437	4.53	4.04	61.1	4.05	1.69	5.97
348.	17.45	36.410	26.504	4.59	****	*****	*****	*****	5.96
373.	17.35	36.386	26.510	4.49	****	*****	*****	*****	5.91
398.	17.14	36.380	26.556	4.44	****	*****	*****	*****	6.13
422.	16.97	36.354	26.577	4.47	****	*****	*****	*****	5.46
447.	16.70	36.311	26.609	4.40	****	*****	*****	*****	5.85
497.	16.08	36.235	26.696	4.32	4.11	83.7	5.42	2.26	5.39
547.	15.26	35.059	25.978	4.28	****	*****	*****	*****	*****
596.	14.50	35.930	26.815	4.28	****	*****	*****	*****	3.99
696.	12.72	35.694	27.004	4.07	4.40	57.9	4.24	1.77	3.67
795.	10.73	35.388	27.145	3.75	4.30	51.8	3.84	1.60	2.01
895.	8.47	35.181	27.363	3.75	4.46	36.0	3.01	1.25	1.17
994.	7.14	35.128	27.520	4.16	4.16	27.5	2.40	1.00	0.93

STATION S75625 31/ 3/75 30.50 X 58.50 DEPTH = 9999. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	19.98	36.634	26.030	5.22	****	*****	*****	*****	*****
27.	19.99	36.633	26.027	5.28	4.32	-8.2	0.11	0.05	6.29
53.	19.71	36.570	26.053	5.31	4.38	-12.2	-0.14	-0.06	6.23
80.	19.73	36.473	25.974	5.24	****	*****	*****	*****	6.19
106.	19.69	36.569	26.058	5.28	4.07	5.7	0.92	0.39	6.65
131.	19.26	36.514	26.128	5.00	4.44	3.3	0.81	0.34	6.20
157.	18.99	36.477	26.169	4.82	4.69	17.0	1.72	0.72	*****
182.	18.73	36.470	26.231	4.70	4.04	18.9	1.68	0.70	6.85
207.	18.40	36.449	26.298	4.64	4.16	34.5	2.61	1.09	6.25
232.	18.22	36.452	26.346	4.59	****	*****	*****	*****	6.47
257.	18.02	36.442	26.388	4.58	4.40	38.3	2.96	1.23	6.38
282.	17.84	36.432	26.425	4.56	****	*****	*****	*****	6.53
307.	17.59	36.414	26.473	4.53	4.08	73.9	4.81	2.00	6.29
332.	17.40	36.407	26.514	4.49	****	*****	*****	*****	6.45
346.	17.32	******	26.528	4.48	4.24	77.7	5.20	2.17	6.32
370.	17.08	36.394	26.581	4.47	4.33	77.7	5.30	2.21	*****
395.	16.86	36.331	26.586	4.46	4.44	81.8	5.68	2.37	6.21
419.	16.73	36.318	26.607	4.36	****	*****	*****	*****	5.96
443.	16.34	36.235	26.635	4.37	4.03	88.3	5.58	2.33	5.69
492.	15.59	36.115	26.716	4.35	****	*****	*****	*****	5.78
541.	14.76	35.995	26.809	4.26	****	*****	*****	*****	5.27
591.	14.02	35.861	26.865	4.26	****	*****	*****	*****	4.70
691.	12.37	35.624	27.019	3.90	4.23	62.2	4.37	1.82	3.34
791.	9.99	35.330	27.230	3.59	****	45.8	*****	*****	2.12
891.	8.08	35.170	27.415	3.83	4.30	31.1	2.65	1.10	0.88
991.	6.91	35.152	27.571	4.36	4.32	30.4	2.64	1.10	1.27

STATION S75626 31/ 3/75 30.50 X 56.50 DEPTH = 9999. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^-8)	DEL-3HE (%.)	XS-3HE (CC/GX10^-15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	20.10	36.659	26.018	5.19	****	*****	*****	*****	6.63
49.	20.05	******	26.025	5.19	4.61	-5.1	0.27	0.11	*****
74.	20.04	36.644	26.022	5.21	****	1.1	*****	*****	6.72
98.	20.05	36.647	26.022	5.19	****	*****	*****	*****	*****
122.	20.03	36.646	26.026	5.18	****	*****	*****	*****	6.59
147.	19.15	36.519	26.160	4.83	****	*****	*****	*****	6.14
172.	18.61	36.494	26.279	4.70	****	*****	*****	*****	6.66
196.	18.04	36.454	26.392	4.60	****	*****	*****	*****	6.46
221.	17.59	36.413	26.472	4.58	****	*****	*****	*****	6.24
246.	17.38	36.394	26.509	4.51	****	*****	*****	*****	6.47

STATION PAN001 30/ 3/77 32.17 X 64.50 DEPTH = 3015. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	19.17	36.546	26.176	5.63	3.91	-10.1	0.06	0.03	5.02
10.	18.88	36.546	26.250	5.74	3.91	-11.8	-0.02	-0.01	5.24
25.	18.85	36.539	26.253	5.52	3.99	-1.7	0.52	0.22	5.18
50.	18.87	36.545	26.252	****	3.91	-3.1	0.45	0.19	5.27
75.	18.82	36.540	26.261	5.41	3.84	-18.4	-0.36	-0.15	4.94
100.	18.77	36.540	26.274	5.37	3.90	-8.6	0.15	0.06	5.28
150.	18.55	36.495	26.2[illegible]5	5.20	4.53	-8.8	0.07	0.03	5.10
200.	18.39	36.495	26.336	5.17	3.90	4.6	0.87	0.36	4.82
250.	18.30	36.469	26.339	4.92	****	*****	*****	*****	*****
300.	17.97	36.456	26.411	4.71	3.99	28.7	2.22	0.92	5.32
350.	17.51	36.407	26.487	4.54	3.90	82.4	5.08	2.12	5.64
400.	17.21	36.378	26.538	4.50	3.88	86.8	5.30	2.21	5.46
500.	15.97	36.177	26.676	4.34	3.91	85.4	5.28	2.20	4.87
600.	14.54	35.946	26.819	4.29	4.04	72.4	4.73	1.97	3.98
700.	12.26	35.604	27.025	3.88	3.89	52.4	3.55	1.48	2.77
800.	9.89	35.311	27.232	3.61	4.23	36.5	2.91	1.21	1.86
900.	8.36	35.179	27.379	3.84	4.08	35.3	2.79	1.16	1.39
1000.	6.51	35.098	27.583	4.64	4.14	41.3	3.19	1.33	1.32
1200.	5.09	35.066	27.738	5.66	4.08	42.3	3.24	1.35	1.63
1400.	4.43	35.032	27.786	5.98	4.28	22.2	2.18	0.91	1.56
1600.	4.01	35.012	27.816	6.18	4.36	14.4	1.74	0.72	0.77
1800.	3.79	35.002	27.831	6.23	****	*****	*****	*****	*****
2000.	3.59	34.999	27.849	6.23	4.25	6.0	1.23	0.51	0.21
2200.	3.38	34.987	27.860	6.23	4.02	7.6	1.31	0.54	0.24
2400.	3.00	34.978	27.889	6.23	5.04	7.8	1.44	0.60	0.35
2600.	2.95	34.972	27.889	6.29	4.77	5.8	1.28	0.53	*****

STATION PAN002 11/ 5/77 32.17 X 64.50 DEPTH = 3015. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	20.35	36.565	25.879	5.63	3.92	-11.5	-0.03	-0.01	5.03
10.	20.25	******	25.903	5.45	4.35	-10.2	-0.02	-0.01	5.81
25.	20.24	36.558	25.903	5.56	4.03	-9.0	0.09	0.04	4.81
50.	19.42	36.568	26.127	5.47	3.98	-8.8	0.12	0.05	4.77
75.	18.69	36.514	26.274	5.28	4.01	-9.5	0.09	0.04	4.60
100.	18.43	36.499	26.329	5.35	3.78	-7.6	0.23	0.09	5.29
150.	18.32	36.494	26.353	5.10	3.99	-2.4	0.49	0.21	4.94
200.	18.25	36.500	26.375	5.03	4.00	-4.0	0.41	0.17	5.01
250.	18.28	36.495	26.364	5.10	4.59	9.0	1.20	0.50	4.35
305.	18.20	36.488	26.378	5.20	4.00	7.9	1.06	0.44	4.54
355.	18.04	36.474	26.408	5.12	3.97	23.9	1.94	0.81	5.09
405.	17.57	36.419	26.482	4.80	3.90	72.0	4.52	1.89	6.00
505.	16.34	36.228	26.630	4.56	4.23	81.8	5.45	2.27	4.75
600.	15.01	36.014	26.768	4.26	4.62	67.2	4.98	2.07	4.55
700.	13.20	35.736	26.940	4.11	4.10	62.9	4.28	1.78	3.77
800.	10.49	35.366	27.171	3.75	3.95	40.3	2.96	1.23	1.50
900.	8.84	35.192	27.313	3.67	4.06	32.7	2.62	1.09	1.41
1000.	7.09	35.123	27.523	4.45	4.28	32.3	2.73	1.14	1.19
1200.	5.09	35.050	27.725	5.48	4.07	41.8	3.21	1.34	1.68
1400.	4.42	35.024	27.781	5.91	4.55	42.0	3.51	1.46	1.44
1600.	4.01	35.000	27.806	6.18	4.13	26.5	2.39	0.99	0.67
1800.	3.81	34.991	27.820	6.26	4.22	-0.6	0.84	0.35	0.39
2005.	3.72	34.996	27.833	6.24	4.25	7.5	1.32	0.55	0.14
2205.	3.38	34.981	27.855	6.20	4.30	8.2	1.37	0.57	0.08
2405.	3.08	34.978	27.881	6.18	4.42	9.9	1.50	0.62	0.16
2605.	2.95	34.967	27.885	6.18	4.39	16.0	1.87	0.78	0.05

STATION PAN003 30/ 6/77 32.17 X 64.50 DEPTH = 3015. M.
****

DEPTH (M)	POTEMP (DEG-C)	SALINITY (%.)	SIG-THETA (%.)	OXYGEN (ML/L)	HE CONCN (CC/GX10^8)	DEL-3HE (%.)	XS-3HE (CC/GX10^15)	XS-3HE (T.U.)	TRITIUM (T.U.)
1.	25.37	36.161	24.125	5.23	5.15	-7.5	-0.02	-0.01	3.93
10.	24.87	******	24.465	5.20	3.91	-12.6	-0.16	-0.07	3.94
25.	22.19	36.657	25.441	5.48	4.00	-11.9	-0.09	-0.04	4.84
50.	20.21	36.610	25.951	5.51	4.12	-16.3	-0.33	-0.14	4.50
75.	19.45	36.554	26.109	5.38	4.24	-8.2	0.13	0.05	4.71
100.	19.01	36.525	26.201	5.21	4.39	-8.8	0.08	0.03	4.58
150.	18.53	36.488	26.295	5.04	3.88	3.0	0.78	0.33	4.56
200.	18.24	36.488	26.368	5.19	4.06	-2.4	0.49	0.20	4.58
250.	18.17	36.490	26.387	5.09	4.20	3.0	0.80	0.33	4.94
300.	18.04	36.496	26.424	5.29	4.28	3.1	0.81	0.34	4.69
350.	17.98	36.495	26.439	5.13	4.09	-3.2	0.45	0.19	4.41
400.	17.66	36.455	26.487	4.85	3.94	30.5	2.30	0.96	5.23
505.	16.24	36.216	26.644	4.37	3.98	95.1	5.90	2.46	4.69
595.	14.69	35.968	26.803	4.26	4.42	64.4	4.62	1.93	3.64
695.	12.65	35.656	26.989	4.12	4.41	55.7	4.12	1.72	3.02
795.	10.17	35.336	27.203	4.02	4.08	46.2	3.37	1.40	1.94
895.	8.06	35.134	27.390	3.73	4.08	27.0	2.32	0.97	1.19
995.	6.67	35.113	27.574	4.48	4.24	31.4	2.67	1.11	1.58
1195.	4.99	35.047	27.735	5.52	4.63	40.3	3.44	1.43	1.56
1395.	4.12	35.010	27.803	5.92	4.11	35.2	2.88	1.20	1.39
1595.	3.97	34.993	27.805	6.08	4.41	8.3	1.38	0.57	0.81
1800.	3.81	35.002	27.829	6.09	****	*****	*****	*****	0.41
2000.	3.59	35.006	27.854	6.13	4.78	9.2	1.49	0.62	0.20
2200.	3.38	34.987	27.860	6.13	4.39	-1.4	0.80	0.33	0.05
2405.	3.04	34.977	27.884	6.14	4.40	10.0	1.50	0.62	0.26
2605.	2.94	34.967	27.886	6.09	4.51	1.1	0.96	0.40	0.12

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(Research and Advanced Technology)
Military Assistant for Environmental Science
Room 3D129
Washington, D.C. 20301

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WOODS HOLE OCEANOGRAPHIC INSTITUTION HELIUM ISOTOPE LABORATORY DATA RELEASE NO. 1 by W. J. Jenkins, W. V. Collentro and R. D. Boudreau. July 1979. 27 pages. Prepared for the Office of Naval Research under Contract N00014-74-C-0262; NR 083-004 and for the National Science Foundation under Grant OCE 76-20485.

This report summarizes technique, estimated precisions and results for ^{3}H and ^{3}He analyses made on three cruises in the Sargasso Sea. In addition, a statistical treatment is made on 36 surface (≤ 10 m) $^{3}He/^{4}He$ analyses to obtain an estimate of the solubility isotope effect and its temperature dependence to be $(\alpha - 1) \times 1000\ ^{o}/oo = -(17.3 \pm 0.8) + (0.28 \pm 0.06)\ T\ (^{o}C)$ with a regression scatter of 2.6 $^{o}/oo$ and a linear correlation coefficient of 0.640.

1. ^{3}H, ^{3}He Data in Sargasso Sea
2. Fall-out isotopes
3. Helium isotope effect on solution in sea-water

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II. Collentro, W. V.
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